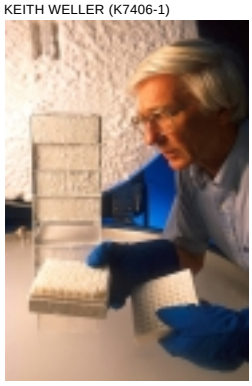
A Healthy History

National Center for Agricultural Utilization Research Marks 60 Years

Always an abundant source of food and fiber, U.S. agriculture provides an ever-broadening array of technologies to improve the quality of life. Medical use of farm products is no exception, thanks to research begun in a big way 60 years ago. Now, as in those early days, teams of Agricultural Research Service scientists work toward their goals with partners in academia and industry.

"While the mission of some of our research centers has always been to find new uses for agricultural products, we believe spinoffs of new discoveries that can be applied to other endeavors are unlimited," says Peter B. Johnsen, director of the National Center for Agricultural Utilization Research (NCAUR), Peoria, Illinois.

KEITH WELLER (K7406-1)



Microbiologist Cletus Kurtzman retrieves yeasts from the ARS Culture Collection.

Setting in motion a string of medically related discoveries at Peoria was a historic telegram received by center director Orville E. May on July 9, 1941. The telegram asked for the center's participation with Oxford University scientists Howard Florey and Norman Heatley in research on pilot-scale production of penicillin. Cooperative research, which would soon involve industrial partners like Merck, Squibb, Lilly, and Pfizer, began immediately. That was just months before the United States entered World War II and within a year of when the center and three other new U.S. Department of Agriculture utilization research laboratories opened their doors. Their mission was to find uses for surplus farm commodities in the era of the Great Depression.

The NCAUR penicillin research team invented deep-tank fermentation technology to mass-produce the infection-fighting lifesaver, and the antibiotics industry was born. The *Penicillium* strain they discovered, NRRL 1951, is the parent of most modern commercial *Penicillium* strains. As early as May 1943, some 1,500 military people were being treated with penicillin in one hospital. Only a year later, countless lives were saved in connection with the Allied invasion of Normandy on D-Day—June 6, 1944.

When the U.S. military became involved in the Korean war, scientists at NCAUR quickly made an all-out effort to develop an economical way to mass-produce dextran, a polysaccharide. Dextran is produced when a strain of the bacterium *Leuconostoc mesenteroides* acts on cane or beet sugars. Dextran was quickly approved as a blood extender for use in military medicine in 1950 and for civilian use in 1953.

(K9422-1)

Andrew Moyer, in his Peoria laboratory, discovered the process for mass producing penicillin.

A common thread in the penicillin and dextran developments was microbiological expertise and resources. Shortly after the Korean war, the dextran research team tapped a strain of the bacterium *Xanthomonas campestris* from among microbes at NCAUR to develop xanthan gum, a thickening substance with food and industrial applications.

In the early 1940s, the lab possessed a collection of nearly 1,200 mold strains. Today, the ARS Culture Collection at NCAUR has more than 80,000 microbial strains.

"Modern DNA technologies now allow us to accomplish in a few thousand hours of work what we might have achieved in whole careers, as we tap into the vast reservoir of genetic resources in the ARS Culture Collection," says Cletus P. Kurtzman, research leader of NCAUR's Microbial Properties Unit. For example, through a cooperative research and development agreement (CRADA), Boston Probes, Inc., and ARS scientists are deciphering genetic information to identify potential disease-causing organisms throughout the entire collection of about 10,000 ascomycetous yeast strains. Among these are *Candida* species that are the cause of skin and deep-tissue infections.

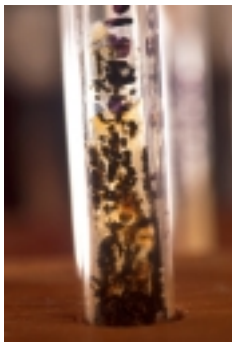
New microorganisms are often needed,

SCOTT BAUER (K7218-20)

Many medical and personal care products contain the absorbent compound Super Slurper developed at NCAUR.

and they can be found more readily than ever before. In the late 1990s, NCAUR microbiologist Stephen W. Peterson and colleagues found 39 new *Penicillium* species, the largest such discovery described by any person or group since the genus was first described in H.F. Link's 1809 dissertation. Peterson added the new species to the ARS Culture Collection, alongside 102 previously known *Penicillium* species, including the ones NCAUR scientists used to help launch the antibiotics industry.

KEITH WELLER (K8611-12)



***Penicillia* sp. growing on decaying wood.**

The *Penicillia* were among 1,300 different microscopic fungi found growing in a collection of wood-decay specimens. NCAUR microbiologist Donald T. Wicklow and his colleagues, with help from the Biotechnology Research and Development Corporation (BRDC) in Peoria, have produced thousands of extracts from the fungal cultures and have shared those extracts with BRDC member companies. The companies are screening them for chemicals that might serve as agricultural pesticides, animal health products, and antifungal antibiotics.

In the 1970s, NCAUR scientists invented Super Slurper, a starch polymer that can be used in hospital bedding, bandages, and personal care products to absorb blood, urine, and moisture.

More recently, research on anaerobic microbes in cattle rumens led to collaboration between NCAUR biochemist Terence R. Whitehead and researchers concerned with human diseases such as gingivitis, colon cancer, endocarditis, and meningitis. NCAUR microbiologist Kerry O'Donnell's research to genetically characterize human disease-causing strains among fungi in the ARS Culture Collection's *Fusarium* species (normally associated with plant diseases) should benefit scientists working on diagnostic tests for clinical problems, such as eye infections.

Other projects relate to health and the environment. Notable examples include the 1940s development of deep-tank microbial production of riboflavin—vitamin B_2—and 1990s processes that chemist George E. Inglett developed to extract fiber from grains for use as food ingredients like Oatrim and Nutrim, which can replace fat and increase soluble-fiber content.

The research on deep-tank fermentation that helped launch the antibiotics industry may have a modern counterpart: the beginnings of an industry to produce environmentally friendly microbial biopesticides. NCAUR microbiologist Mark A. Jackson and his colleagues are fine-tuning mass production of insect-battling microbes, using a deep-tank fermentation technique similar to those used commercially to produce alcohol and baker's yeast.

KEITH WELLER (K9512-2)

Microbiologist Mark Jackson examines a fungal culture that will be used to mass produce a biopesticide for silverleaf whitefly.

A newly renovated pilot plant within the center is advancing technology on an invention by NCAUR chemists George F. Fanta and the late Kenneth Eskins. That invention, called Fantesk™, a starch-water-oil composite with unusual physical properties, has a wide range of potential applications. Large amounts of the composite will be manufactured for research and product use in the new pilot plant under a CRADA with Hy-Gene Biomedical Corporation, of Ventura, California. Hy-Gene holds an exclusive license with ARS for medical products and a nonexclusive license for cosmetic applications.

Cooperative research involving NCAUR and the Peoria branch of the University of Illinois Medical School points to other medical applications for Fantesk. The product may become a vehicle to carry injectable pharmaceuticals dissolved in 0.1- to 10-micron-diameter oil droplets to the circulatory systems of humans and animals.

KEITH WELLER (K9256-8)

Fantesk co-inventor George Fanta (chemist) uses a steam jet-cooking process to make the substance.

In other cooperative research, NCAUR chemist Mark A. Berhow, plant physiologist Steven F. Vaughn, chemist Charles L. Cantrell, and their University of Illinois colleagues are prospecting for components in soybeans and other agricultural products that might help animals and humans stay cancer free. While some natural and synthetic chemicals disrupt DNA, sometimes resulting in malignancies, other compounds help protect against this type of irreversible damage. Researchers hope to find DNA-friendly compounds—called chemoprotectants—to counter the unfriendly ones in food and the environment.—By **Ben Hardin,** ARS.

This research is part of New Uses, Quality, & Marketability of Plant & Animal Products (#306), an ARS National Program described on the World Wide Web at http://www.nps.ars.usda.gov.

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